WATERSHED WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

UPPER MULBERRY RIVER WATERSHED

BARROW, GWINNETT, HALL, AND JACKSON COUNTIES, GEORGIA

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ADDENDUM

Upper Mulberry River Watershed

Georgia

December 19, 1973

The purpose of this addendum is to show the effects of 6 7/8 % interest rate, current normalized prices and current construction costs.

Annual project costs, benefits and benefit-cost ratio are as follows:

1.	Annual project cost	-	$ 214,098
2.	Annual project benefits	-	267,107
3.	Benefit-cost ratio	-	1.2:1.0

The alternative selected for implementation, as contained in this work plan, is based on a careful and deliberate consideration of the environmental and economic impacts of the project. There are no known unresolved environmental issues. Comments on the draft environmental statement stressed the need for a more detailed description of resources and problems. The final environmental statement has been modified in response to such comments.

WATERSHED WORK PLAN

UPPER MULBERRY RIVER WATERSHED
Barrow, Gwinnett, Hall, and Jackson Counties, Georgia

Prepared under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by:

Upper Chattahoochee River Soil and Water Conservation District
Upper Ocmulgee River Soil and Water Conservation District
Oconee River Soil and Water Conservation District
Barrow, Gwinnett, Hall, and Jackson Counties, Georgia
City of Winder, Georgia
Town of Braselton, Georgia
State Highway Department

With Assistance by:

U. S. Department of Agriculture
Soil Conservation Service
Forest Service

April 1971

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Upper Mulberry River Watershed
Barrow, Gwinnet, Hall, and Jackson Counties, Georgia

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SUMMARY OF PLAN

The Upper Mulberry River Watershed is located in the Upper Piedmont Soil Province of North Georgia and has a drainage area of approximately 61,481 acres. The Upper Chattahoochee River, Oconee River, and Upper Ocmulgee River Soil and Water Conservation Districts, Barrow, Gwinnett, Hall, and Jackson Counties, the city of Winder and the town of Braselton, and the State Highway Department are the sponsoring local organizations for this watershed project.

Principal watershed problems are the erosion of upland soils, including gullies and bare roadbanks, the frequent flooding on about 2,780 acres of very productive agricultural flood plain lands, and the need for future municipal and industrial water supplies for the town of Braselton and the city of Winder.

There are 43,011 acres of woodland presently in the watershed. This acreage will be reduced by about 2,000 acres in the future with most of this going to pastureland.

Forestry measures are proposed on 5,782 acres and include critical area stabilization and watershed protection practices. The U. S. Forest Service, by and through the Georgia Forestry Commission, will provide technical assistance in the planning and installation of the forestland treatment measures. The landowners and operators will maintain the treatment measures on their lands.

The works of improvement planned for the project are land treatment and structural measures.

Land treatment measures are vegetative and mechanical practices that will protect and improve the soil and water resources in the watershed. The total installation cost of these measures is estimated to be $735,971. Other funds will provide $628,557 of this cost while the P. L. 566 share will amount to $107,414.

Structural measures planned are 7 floodwater retarding structures, 2 multiple-purpose structures for flood prevention and municipal water storage, selective debris removal from approximately 8,750 feet of stream, approximately 85,675 linear feet of streambank protection measures and 241 acres of critical area planting. These measures will be installed at an estimated cost of $1,908,883. P. L. 566 funds will provide $1,576,186 of the cost and $332,697 will be furnished from other funds.

It is planned that all works of improvement will be installed within a

period of five years at a total estimated cost of $2,644,854. P. L. 566 funds will bear $1,683,600 or 64 percent of this cost and $961,254 or 36 percent will be borne by other funds.

The planned works of improvement will (1) provide for adequate land treatment measures which will help control upland erosion, (2) furnish the level of flood protection to the major portion of the flood plain land that will permit its most efficient use for agricultural production, and (3) provide storage of water for future municipal and industrial use.

All land treatment measures will be operated and maintained by individual landowners under cooperative agreements with their respective soil and water conservation districts.

Barrow, Hall, and Jackson counties will be responsible for the operation and maintenance of the 241 acres of critical area planting in their respective counties. The county governments concerned will be responsible for the operation and maintenance of the floodwater retarding structures, streambank protection, and channel improvement that are installed in their respective portions of the watershed. The town of Braselton will be responsible for the operation and maintenance of multiple-purpose structure number 10. The city of Winder will be responsible for the operation and maintenance of multiple-purpose structure number 21. It is estimated that the average annual cost for operation and maintenance of all structural measures will amount to $8,313.

The estimated average annual cost of installing, operating, and maintaining the structural measures is $106,637 and the average annual benefits to be derived from these measures are estimated to be $151,428. This gives a benefit-cost ratio of 1.4 to 1 for the project.

DESCRIPTION OF THE WATERSHED

Physical Data

Upper Mulberry River Watershed is located in the Altamaha River Basin in the northern Piedmont Physiographic Province of northeast Georgia. Portions of the counties of Barrow, Gwinnett, Hall, and Jackson are located within the watershed boundary. The small towns of Braselton and Hoschton are located along the eastern boundary. Auburn and Carl, two small communities in Barrow County, are located along the southern boundary. The city of Gainesville, the county seat of Hall County, is about 6 miles from the northeast boundary of the watershed and the city of Winder, the county seat of Barrow County, is about 5 miles south of the watershed.

The watershed is about 61,481 acres in size. There are 16,066 acres in Barrow County, 18,058 acres in Gwinnett County, 21,375 acres in Hall County, and 5,982 acres in Jackson County.

The upper reaches of Mulberry River and the Little Mulberry River drainage areas make up the project area and are hydrologic units within themselves for evaluation purposes. The confluence of Little Mulberry River with Mulberry River is the lower extremity of the watershed boundary.

The headwaters of Mulberry River are in the southwest portion of Hall County near the community of Blackshear Place. The main stream flows in a south-southeasterly direction through Hall County and becomes the Barrow-Jackson County boundary as it flows through these counties to the end of the project area. Numerous tributary streams enter the river from the west, north, and northeast. The Upper Mulberry River drainage area contains 41,769 acres.

The headwaters of Little Mulberry River are in the eastern portion of Gwinnett County near the small community of Hog Mountain and Interstate Highway 85. The main stream flows in an easterly direction through Gwinnett and Barrow Counties to the end of the project area. Rock Creek is a major tributary stream that enters Little Mulberry River just upstream from State Highway 211. The Little Mulberry River drainage area contains 19,712 acres.

The watershed is readily accessible by a good system of State and Federal highways and Interstate Highway 85, a main line of the Seaboard Airline Railroad, and the Gainesville and Winder Airports.

Forestland comprises 70 percent or 43,011 acres of the watershed area. The present hydrologic condition of the forestlands, based on 5 hydrologic condition classes is: 0 percent, very good; 7 percent, good; 20 percent, fair; 56 percent, poor; and 17 percent, very poor. The future hydrologic condition will be 3 percent, very good; 30 percent, good; 67 percent, fair; and 0 percent, poor or very poor. The present poor condition is caused primarily by overgrazing, overcutting and burning in the past and by cultivation of lands which have now returned to forests. Approximately 53 percent of the present forestland has been under cultivation in the past 50 to 60 years. The hydrologic condition of the forestlands is improving and under proper management and protection it will continue to improve.

The mean annual rainfall is 53 inches. Mean monthly temperatures range from 43 degrees Fahrenheit during the winter months to 78 degrees Fahrenheit during the summer months. The normal growing and harvest season is from March 15 to November 30.

The watershed lies in the South Atlantic and Gulf Slope Cash Crop, Forest and Livestock Region and the Southern Piedmont Land Resource Area. The upland soils of the watershed in the upstream half are mainly Cecil, Madison, and Appling associations. Only about 25 percent of the topsoil has been removed by erosion in the steeper upper half of the watershed. The upland soils of the downstream half are the Cecil, Lloyd and Davidson associations. Approximately 80 percent of the topsoil in the lower half of the watershed has been removed by erosion. All of these soils are well drained, medium to strongly acid and subject to erosion if adequate conservation practices are not applied. Flood plain soils are mainly Congaree (IIw) with small areas of Wehadkee (IVw). These soils are very fertile and strongly acid in reaction.

The headwaters of Mulberry River rise in the Brevard schist portion of the Piedmont Province and flow southeasterly. The major portion of the rocks are of probable Pre-Cambrian age generally called the Carolina series,

gneisses and schists with some granite and dolerite intrusives at later age. The major rock types are Brevard schist, quartzite, marble, granite gneiss, hornblende gneiss, and biotite gneiss. Small quartz veins, pegmatites, and dolerite dikes are common.

The regional trend of the local rock is northeast to southwest with the major portion of the dips to the southeast. Highly resistant unweathered rock exercises structural control over stream patterns and valley shapes. The major drainage patterns are dendritic (tree-like) in nature with areas of trellis-like drainage in the Brevard schist portion.

The topography is moderately steep in the upper portion, being deeply incised with short, steep slopes and numerous valleys. More gentle rolling topography prevails in the lower portion of the watershed. Elevation extremes range from approximately 1,330 feet above mean sea level to a low point of 740 feet above mean sea level at the end of the project boundary in the vicinity of the Mulberry River, Little Mulberry River intersection.

Economic Data

There are approximately 557 farms in the watershed averaging about 110 acres in size.

The major farm enterprises are poultry and poultry products; livestock, dairy, and their products; and row crops, principally corn, cotton and wheat. Principal crops grown in the flood plain are corn, hay, and pasture grasses. Without project average yields are 70 bushels of corn per acre, 2.5 tons of hay per acre, and 250 pounds of beef per acre on pasture grasses. Present land use in the watershed is 3,868 acres of cropland, 43,011 acres of woodland, 9,960 acres of pasture, 1,500 acres in idle and wildlife, and 3,142 acres in miscellaneous uses.

Most of the land in the watershed is privately owned. Public land consists of small acreages of city, county, and state owned properties such as schools, roads, parks, etc. Commercial timberland companies own or lease approximately 15 to 20 percent of the forestland acreage.

The towns of Auburn and Carl are located on the southern boundary of the project area and Hoschton and Braselton are located on the eastern boundary of the project area. Urban population is estimated to be 600. The total watershed population is estimated to be 6,700.

The U. S. Census of Agriculture indicates that 55 percent of the farms have sales of less than $2,500 annually. It also shows that 47 percent of the farm operators were working off the farm 100 days or more. Major industrial activities are located outside the project area in Gainesville, Lawrenceville and Winder. Apparel manufacturers in Braselton and Hoschton offer employment opportunities to approximately 600 persons.

Barrow, Hall, Jackson, and Gwinnett Counties are in the Appalachian Region of Georgia as designated by the Appalachian Regional Development Act of 1965 (P. L. 89-4). Hall and Gwinnett Counties are in designated Resource Conservation and Development Projects.

Land values in the project area are relatively high because of its proximity to major urban areas and highways, etc. Upland land values range from $250 to $500 per acre. Flood plain land values range from $300 to $500 depending on soil capabilities and water hazards. Urban land in the area is valued at about $2,000 per acre and projected future values are estimated to be approximately $4,000 per acre. The area is readily accessible to markets in Winder, Gainesville, Lawrenceville, and Atlanta by a good system of Federal, State and County roads as well as rail transportation.

Land Treatment Data

A substantial amount of classes IVe and VIe upland is being improperly used for cropland and improved pasture. There are some areas of classes IIw, IIIw, and IVw flood plain lands that are presently idle or in low grade woods or unimproved pastures. This land use pattern leads to inefficient employment of land, labor, and capital. About 63 percent of the land in the watershed is in capability classes IVe, VIe, and VIIe; about 29 percent in classes I, IIe, and IIIe; and about 8 percent in classes IIw, IIIw, and IVw. Converting cropland, unimproved pasture, and low grade woods to improved pastures and other uses will be the major land use changes as a result of this project.

The Oconee River, Upper Chattahoochee River, and Upper Ocmulgee River Soil and Water Conservation Districts, in cooperation with the Soil Conservation Service, are presently providing technical assistance to individual landowners and operators under the authority of P. L. 46.

Approximately 295 operators are district cooperators with about 95 percent having basic conservation plans. More than 55 percent of the project area is covered by district agreements and about 65 percent of the planned practices have been applied. This project will provide additional technical assistance under the authority of Public Law 566 to accelerate the installation of needed land treatment measures.

Fish and Wildlife Resource Data

Wildlife resources consist of low populations of rabbit, squirrel, quail, dove, fox, mink, muskrat, and woodcock. Low to moderate populations of raccoon, waterfowl, and beavers occur in the watershed. Deer are scattered through the project area and are considered to be moderate in population.

Fisheries resources consist of large mouth bass, bluegill, redbreast, chain pickerel, crappie, white suckers, hornyheads, brown bullhead, madtom, and stream minnows. A sample of the stream fisheries was made by the Georgia Game and Fish Commission on a mile and a half section of the Mulberry River upstream from the Georgia Highway 124 bridge on August 4, 1967. An estimated 8 acres of water were sampled and sport fish comprised less than half of the weight of the sample. The sample indicated that the stream had approximately three pounds-three ounces of sport fish per acre. Less than one-half of this poundage per acre

were considered catchable size sport fish. Fisheries resources are considered to be low in value and very little stream fishing occurs in the watershed.

There are about 60 bass-bluegill ponds now in the watershed. Approximately 1,200 acres are presently in wildlife habitat management practices.

WATERSHED PROBLEMS

Land Treatment

Continuous cultivation of upland fields over the years has caused serious erosion problems leaving these fields in a low fertility level. Although there has been a definite change in farming operations from row cropping to livestock and poultry enterprises in recent years, there are still many acres of upland fields needing better conservation treatment than they are receiving. Land use adjustments are needed to efficiently utilize the land in the watershed to its full potential. The unfavorable economic effect of flooding deters the application of needed conservation measures on individually-owned farms since landowners and operators are forced to commit their capital resources first to production practices that have a direct bearing on immediate income. This leaves very little or no capital for investment in conservation land treatment measures that produce benefits more in the future than immediately.

Floodwater Damage

The 100-year frequency flood would inundate approximately 2,780 acres of very productive agricultural land. Flood plain land is presently valued at approximately $400 per acre. Projected future value of this land is about $500 per acre.

Roads and bridges that cross flood plain land are damaged by high floodwaters that result in costly and time consuming repair. Traffic is interrupted and often has to be rerouted around washed out roads and bridges increasing travel time and costs.

Most of the floods occur during the period of land preparation, growing season, or time of harvest. Frequency of flooding varies from once annually in the upper reaches of Mulberry River to three times annually in its lower reaches. Flooding occurs about three times annually on Little Mulberry River and its tributaries.

The major portion of the flood plain has remained in agricultural uses even though there has been a shift in the acres cultivated for cropland to pasture and other less intensive uses. These restrictions on flood plain uses adversely affect the income of the people owning or operating the land.

Average annual damages to crops and pasture amount to an estimated $9,835. Roads, bridges, and minor fixed improvements damages amount to an estimated $931 per year. Total average annual damage from floodwater is estimated to be $11,705 (Table 5).

Sediment Damage

The major agricultural damage resulting from sediment is brought about by the filling of the outlet ends of farm drainage ditches and tributary channels and the overbank deposition of infertile material. Sediment deposited in the channel has caused a rise in the water table resulting in swamping in a two mile stretch in the upper end of the Little Mulberry River. Elsewhere in the watershed this channel deposition has resulted in an increase in the frequency of overbank flow due to decreased channel capacity and damage to fish habitats.

Severe overbank deposition has caused an estimated 126 acres of flood plain to be damaged approximately 60 percent and 307 acres to be damaged approximately 40 percent.

Overbank flow causes additional damage to wide flood plains in the form of a fine sediment coating on grasses, legumes and shrubs resulting in a serious loss in grazing time for livestock and deer browse. Estimated average annual damage from sediment in the watershed is $10,037.

Swamping as a result of sediment deposition has resulted in $4,733 damages to approximately 190 acres of flood plain lands in the lower reaches of the Little Mulberry River. Additional swamping damages were noted below the watershed.

Further studies were made to determine possible damages being incurred in the area below the watershed as a result of fine sediment being carried in suspension by the Mulberry River. Samples were taken of bedload materials in the main channel at the end of the project for purposes of sieve analysis and comparison of upland soils analysis to determine percent bedload that will be available to be carried in suspension. Comparisons indicated that approximately 34.6 percent of eroded soils will be fine enough for transport as suspended sediment.

In addition to the above damages, studies indicate that the average sediment concentration is at 360 PPM under present conditions. It was also determined that suspended sediment based on normal flow was approximately 35 PPM.

Erosion Damage

Severe erosion is occurring on 241 acres of non-vegetated roadbanks and gullies, 300 acres of openland and 62 acres of forestland. The openland critical eroding areas consist mainly of small shallow gullies or areas where the subsoil has become exposed and natural revegetation has been slow. Borrow pits excavated during the construction of Interstate Highway 65 and immediately adjacent to its right-of-way are mostly bare of vegetation and critically eroding. The critical eroding areas in forestlands are of both the small and large gully type and are eroding faster than natural revegetation can take place.

Roadbank erosion is producing a significant amount of sediment delivered to the streams due to road ditches being usually constructed to empty

directly into large and small streams. Highway maintenance on roads with bare roadbanks is expensive due to sediment accumulations in road ditches which must be removed to provide proper drainage.

Sheet erosion is occurring mainly on cultivated upland and some borrow areas. An estimated 31.8 tons of soil per acre is presently being removed by sheet erosion each year on cultivated land. In recent years, sheet and small gully erosion have been greatly reduced by changed land use and improved conservation practices.

Flood plain scour is somewhat limited and is confined to approximately 50 acres scattered throughout the watershed. Recent flooding has caused some of these scour channels to intensify in size.

Streambank erosion is occurring in the watershed where trees become undermined and fall in the channel causing an interruption in flow. Severe cases of streambank erosion were noted along the main channel in the vicinity of Highway 211 upstream and downstream and in similar locations along Highway 124. This condition, although most critical in the above mentioned areas, is relatively common along the main channel and is further complicated by weak streambank materials in some locations. Physical measurement and aerial photograph analysis indicate that approximately 6.1 acres are lost annually due to streambank erosion.

The estimated average annual erosion damages from all sources amount to approximately $27,459.

Problems Relating to Water Management

Engineering firms employed by the city of Winder and the town of Braselton have determined that both municipalities need additional sources of raw water supply for future growth and development. The present water supply for both municipalities appears to be adequate for present and short-range projections. However, due to their proximity to Interstate Highway 85 and metropolitan Atlanta, it is expected that this area will experience rapid growth similar to other areas adjacent to Atlanta and this will require additional sources of water supply to meet the long-range projected demands. Private engineers have determined that the quantity and quality of the water in the streams on which the reservoirs are proposed is generally adequate for municipal and industrial water storage.

No bona fide interest was manifested by any of the sponsoring local organizations for including storage of water for recreational purposes in the proposed floodwater retarding structures. This is due to the proximity of Lake Lanier and a planned recreational development in an adjacent P. L. 566 watershed project.

It was determined by the Sponsoring Local Organization and the Service that there are no agricultural water management problems in this project that could be alleviated under the provisions of Public Law 566.

PROJECTS OF OTHER AGENCIES

There are no existing or soon to be constructed water resource development projects which will have a direct relationship to the works of improvement included in the work plan.

PROJECT FORMULATION

Possible solutions of the watershed problems within the authorities of Public Law 566 were considered by the Sponsoring Local Organizations and concerned local, State, and Federal agencies in project formulation. Agreement was reached that the following major objectives would be accomplished by the installation of the project:

1. The project will become an outstanding example of soil and water conservation by (a) making desirable land use adjustments which will provide for the efficient and effective utilization of all land within the watershed, (b) establishing the needed conservation practices on the land during the project installation period, and (c) improve the economic conditions of low income farms.

2. Provide from three to five year protection to the major portion of the flood plain land that is flooded about two times annually under present conditions.

3. Provide additional storage of water for municipal and industrial use.

4. Clear channels of obstructions to prevent streambank erosion.

After land treatment measures, floodwater retarding structures were evaluated to determine the structural works of improvement needed to accomplish project objectives. It was determined that land treatment measures and structures would provide the level of protection agreed upon on all reaches in the watershed except the reach of Little Mulberry River from station 547+50 to 638+25 and station 690+00 to 777+50. It was determined that channel improvement, in conjunction with land treatment and floodwater retarding structures, was needed to provide the level of protection agreed upon for the reach of Little Mulberry from station 690+00 to 777+50. However, because of the present and expected future land use no improvement is planned for Little Mulberry from station 547+50 to 638+25. Certain sections of channels between station 314+00 to 932+00 on Upper Mulberry River and station 515+00 to 932+00 on Little Mulberry River are blocked with fallen trees and other debris. These obstructions will be moved for protection against streambank erosion caused by turbulent flow. The system of structural measures selected provides for the agreed upon level of protection to the maximum feasible area of flood plain at the least cost, and with the least possible encroachment on good agricultural land and major fixed improvements. Systems other than the one proposed in this plan were considered but they were not selected due to construction problems, excessive costs, low level of protection, and unfavorable benefit-cost ratios.

Land treatment objectives will be attained by setting goals for the timely installation of conservation practices, planning rotations on cropland that will stay within the allowable soil loss, and developing and utilizing the flood plains that are to be protected by structural measures so that benefits will accrue as predicted. No significant change in farm enterprises is expected as a result of the project.

Fish and wildlife resources were considered in formulating the project. It was brought to the attention of the sponsors and landowners concerned that conditions at floodwater retarding structure no. 9 were conducive for enhancement of waterfowl. The landowners have agreed to install a wildlife gate for waterfowl management at this site which will be paid for with other funds. The remaining improvements of streambank protection, clearing and snagging, and floodwater retarding structures will be beneficial and would probably increase the fisheries from a low to moderate value resource. The waterfowl habitat would be increased due to the watershed structures and proper management of the waterfowl wildlife gate to be constructed in structure no. 9. The upland game habitat will be benefited to some degree by increased development and management of wildlife habitat.

Consulting engineers determined municipal water requirements and selected structure sites 10 and 21 as best suited for inclusion of additional storage for Braselton and Winder.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Land treatment measures are the basic element of the watershed protection and flood prevention projects and they were considered by evaluating land use patterns and trends toward future land use. Agreed-to land treatment objectives will be accomplished by accelerating and emphasizing needed land use adjustments. Installation of these measures is essential for the successful function of the structural works of improvement and they will make a significant contribution toward achieving overall project objectives. Landowners and operators will use work unit technical guides in selecting alternative combinations of these measures to achieve adequate treatment.

Land treatment measures on 3,541 acres of cropland will include gradient terraces, grassed waterways, conservation cropping systems and crop residue use.

Wildlife habitat management measures will improve wildlife habitat on about 1,663 acres of cropland, pasture and idle lands.

Land treatment measures on 11,553 acres of grassland will include farm ponds, pasture and hay planting, and pasture and hay management.

The land treatment measures on forestland will increase soil build-up by stabilizing the soil and by continuous care of the established stands. Forest litter produced under proper forest management and protection is the source of a good humus layer needed to increase

infiltration rates and water storage capacity. Favoring desirable humus building species during cutting operations will assure the development of well aggregated soils and maintain a good humus layer.

A forest management program aimed at fulfilling watershed needs and objectives will be followed. The forestlands will be managed to fulfill timber, wildlife, and recreation needs to the extent that such management is compatible with sound watershed management.

The following program has been prepared from a statement of land treatment needs prepared by the Georgia Forestry Commission and the U. S. Forest Service following a field survey of the watershed, and from land use recommendations by the Soil Conservation Service.

1. Tree Planting - Flood Prevention (82 acres)

   About 82 acres of critically eroding lands within the watershed will be stabilized by planting to loblolly pine or other suitable soil stabilizing species. Site preparation measures will be carried out prior to planting on areas where they are needed. This treatment will increase the rate of water intake and detention storage, and will result in retarding runoff and reducing soil loss and sediment damage.

2. Timber Stand Improvement (5,700 acres)

   This operation is aimed at improving hydrologic condition by manipulation of stand composition and density to create favorable conditions for the maximum production of litter, humus, and forest cover.

3. Going Cooperative Forest Fire Control Program

   The going CFFC Program will accelerate and improve the going fire detection and suppression activities during the installation period. This will result in a reduction in damages to hydrologic and other resource values caused by wildfires.

About 300 acres of critically eroding upland fields will be planted to grasses and legumes.

Land use adjustments will consist primarily in the establishement of existing cropland and woodland to pasture grasses and other uses.

Standard soil surveys have been completed on approximately 43,500 acres (71 percent). It is estimated that about 290 man hours of technical assistance by Soil Scientists will complete the remaining soil survey job.

The total estimated cost of installing all land treatment measures is $735,971 (Table 1).

Structural Measures

The system of structural measures consists of 7 single-purpose floodwater retarding structures, 2 multiple-purpose structures, selective debris removal from approximately 8,750 feet of channel, approximately 85,675 linear feet of streambank protection, and 241 acres of critical area planting. This system is planned to alleviate or reduce overflow of flood plain areas, detain sediment, reduce streambank erosion, flood plain scour, and sediment deposition, and improve channel flow and stability. This system will control runoff from 35,123 acres, which is 57.1 percent of the project drainage area. Total estimated cost of all structural measures is $1,908,883 (Table 2).

All floodwater retarding structures will have earthen embankments with vegetative earth emergency spillways. The principal spillways are planned to be constructed of reinforced concrete water pipes with drop inlets.

Site No. 18 will have a 48-inch diameter pipe (Table 3). The outlet of all principal spillways will be stabilized where unstable conditions exist.

Adequate embankment material is available at all sites. Embankment materials for all structures are fine-grained and are predominantly CL, ML and SM, some of which are micaceous. The use of these materials will require zoning or selective placement on the embankments.

Some rock excavation is anticipated in the emergency spillways of structures 17 and 21.

All class "a" structures are designed with greater than minimum hydrologic criteria. All designed storms were increased half-way from minimum "a" to minimum "b" criteria. All class "b" structures are designed with minimum "b" criteria except that floodwater retarding storage was increased slightly over minimum flood routed requirements on some sites to reduce emergency spillway velocities and capacity requirements. This increase is 0.91 inches on Site 9, 0.48 inches on Site 17 and 0.40 inches on Site 21. Structures 6, 7, 8, 9 and 10 are designed with two-stage drop inlets. The low-stage pool of these structures will store the total runoff from the 24-hour, 5-year frequency storm. All other structures are designed with single-stage drop inlets.

Release rates vary by structure. Maximum low-stage release rates for two-stage structures range from 13.0 to 14.0 C.S.M. Maximum high-stage release rates range from 21.9 to 46.2 C.S.M. (Table 3).

The release rate for all structures is designed to discharge 80 percent or more of the principal spillway storm storage in a ten-day period.

Site No. 9 is planned to contain a water level control gate for waterfowl enhancement. This gate will provide a 4.0 foot drawdown which will

dewater approximately 50 percent of the first 50-years submerged sediment pool. The gate will be designed so that the dewatered portion of the pool can be inundated in one-half foot vertical increments. The cost of this gate will be borne by the landowners with other funds.

The total sediment storage provided in all structures is the 100-year estimate. All single-purpose structures are designed to initially store water in that portion of the reservoir allocated for 80 percent of the first 50-year estimate. The multiple-purpose structures will initially store water in that portion of the reservoir allocated for 80 percent of the 100-year estimate.

Foundation for all principal spillways is yielding except site no. 6, which is rock. Plans are to install a 24-inch diameter pipe on this rock foundation.

Multiple-purpose structures nos. 10 and 21 will provide future water supplies for the town of Braselton and the city of Winder. Plans for withdrawal of water from these structures have not been developed at this time. However, prior to the installation of these reservoirs, plans will be developed for the withdrawal of water.

Proposed channel improvement is confined to the two major tributaries and consists of selective debris removal from approximately 8,750 feet of channel and approximately 85,675 linear feet of intermittent improvement for streambank protection (see Structural Measures Map and Table 3A).

The purpose of debris removal is to increase channel capacity for flood prevention. Selective debris removal will be confined to the perimeter of the channel. Clearing on channel sideslopes will be held to a minimum, and all shrubs and relatively upright live trees which are not significantly reducing flood flows will not be disturbed. The top of the bank area will not be cleared except as required to perform the work. Well anchored material, such as relatively horizontal logs, low projecting stumps and snags, along the channel bottom below the water level that do not create traps on which log jams might form shall not be removed.

The purpose of the streambank protection measure is to remove log jams and trash rafts within the channel so as to reduce channel bank erosion resulting from uprooted trees that block and divert channel flow. A minor amount of streambank stabilization by vegetative and/or structural means will be installed. This work is to be confined to the perimeter of the channel and will consist of the removal of all lodged trees, logs, stumps, snags, piers, piling, and headwalls along the channel bottom that might form blocks and restrict channel flow. Well anchored material, such as relatively horizontal logs, low projecting stumps and snags, along the channel bottom below the water level that do not create traps on which log jams might form shall not be removed. All leaning trees

and snags on the channel bank which will apparently fall into the channel in the near future will be cut and removed. The channel bank clearing is to be held to a minimum and all shrubs and relatively upright live trees will remain undisturbed.

Although there is approximately 16 miles of streambank protection shown in the plan and on the structural measures map, it is estimated that the actual amount to be treated will be approximately 12 miles.

Work roads and travelways in wooded areas where the structural measures are to be installed will be located so as to result in a minimum of disturbance to the flood plain cover. Where road rights-of-way clearing is necessary, the right-of-way will be marked to avoid the destruction of desirable trees.

Two county roads will be involved in site no. 9; the upstream road will be raised and the other one closed. An unimproved road involved in site 10 will be closed. The unimproved road in site 11 will be raised at two locations. Two unimproved roads are involved in site 17; one crossing Mulberry River will be closed and the other raised. Site 18 will require an improved road to be raised at two points. An unimproved road in site 21 will be raised.

EXPLANATION OF INSTALLATION COST

Estimated total project installation cost is $2,644,854 (Table 1). P. L. 566 funds will provide $1,683,600 or 64 percent of this cost and $961,254 or 36 percent will be provided from other funds.

Estimated total P. L. 566 and other obligations for each fiscal year during the installation period is as follows:

Land Treatment Measures

Year	P. L. 566	Other	Total
First	$ 25,000	$125,000	$150,000
Second	25,000	125,000	150,000
Third	25,000	125,000	150,000
Fourth	25,000	125,000	150,000
Fifth	7,414	128,557	135,971
Total	$107,414	$628,557	$735,971

Structural Measures

First	$200,000	$ 50,000	$250,000
Second	300,000	65,000	365,000
Third	400,000	75,000	475,000
Fourth	350,000	70,000	420,000
Fifth	326,186	72,697	398,883
Total	$1,576,186	$332,697	$1,908,883

Land Treatment and Structural Measures

Year	P. L. 566	Other	Total
First	$ 225,000	$175,000	$ 400,000
Second	325,000	190,000	515,000
Third	425,000	200,000	625,000
Fourth	375,000	195,000	570,000
Fifth	333,600	201,254	534,854
Total	$1,683,600	$961,254	$2,644,854

Land Treatment Measures

The total cost of installing the land treatment measures is estimated to be $735,971 (Table 1). P. L. 566 funds will provide $107,414 of this cost and $628,557 will be provided from other funds.

Estimated cost of the land treatment measures on openland is $646,071. P. L. 566 funds will provide $89,514 of this cost and $556,557 will be provided from other funds. P. L. 566 funds of $41,514 will be provided for accelerated technical assistance of conservation plans and application of practices and $48,000 for establishing grasses and legumes on critical eroding fields. Other funds include $12,000 local cost sharing for establishing grasses and legumes on critical eroding fields. The remaining other funds in the amount of $544,557 includes technical assistance under the going P. L. 46 program and the local landowners cost of planning and establishing soil and water conservation and wildlife practices on cropland, grassland, and idle land, utilizing the cost sharing assistance available through the Rural Environmental Assistance Programs in Barrow, Gwinnett, Hall, and Jackson Counties.

The cost of installing the forestry phase of the private land program was developed by the U. S. Forest Service and the Georgia Forestry Commission. The technical assistance cost was based on the present cost of the going Cooperative Forest Management Program. The measure installation costs were based on the present prices by landowners and operators to establish individual measures in the locality. The amount of private forestland treatment measures needed to meet treatment goals was based on a field survey of the watershed, adjusted for expected landowner participation during the installation period.

The estimated cost of the forest land treatment program is $89,900. Of this, $17,900 are from P. L. 566 funds, and $72,000 are from other funds. The P. L. 566 funds are for cost sharing in critical area stabilization work and accelerated technical assistance. The Georgia Forestry Commission will provide $2,300 for accelerated technical assistance, a capital outlay of $5,300 to accelerate and improve the going Cooperative Forest Fire Control Program, and services valued at $6,500 under the going Cooperative Forest Management Program. The landowners and operators will provide $57,900 for installation of the measures on their lands.

Structural Measures

The estimated total cost of all structural measures, excluding project administration, is $1,713,737 of which $1,648,258 is allocated to flood prevention and the remaining $65,479 is allocated to municipal and industrial water storage.

P. L. 566 will provide funds in the amount of $975,391 for the construction of 7 single-purpose floodwater retarding structures, approximately 8,750 feet of selective debris removal, approximately 85,675 linear feet of streambank protection, and 241 acres of critical area planting. This cost is based on the engineer's estimate for similar-type measures in the area plus a contingency allowance of 12 percent of the estimate for items or conditions that could be encountered during construction which are not evident at the present time.

The total engineering cost for these single-purpose structural measures is estimated to be $146,310, all of which will be provided with P. L. 566 funds.

Land rights cost for these measures are estimated to be $238,625, all of which will be provided with other funds.

The value of the land rights for the land area (1,256 acres) affected by the installation of these measures is $79,125. The cost of modifying roads, bridges, and other fixed improvements amounts to $159,500. Of this amount, $153,000 are allocated for modification of Hall County roads at sites 17 and 18. The remainder, $6,500 are allocated for modification of Gwinnett County roads at sites 9 and 11. No cost is allocated for closing of road through site 10.

The allocation of cost to purpose for multiple-purpose structures 10 and 21 is in accordance with the Use of Facilities Method as follows:

Multiple-Purpose Structure 10
Allocation of Total Cost

	Item	Flood Prevention	Municipal Water Supply	Total
1.	Total Capacity (Ac.Ft.)	962[1/]	150	1,112
2.	Percent Total Capacity	86.51	13.49	100.00
3.	Allocated Joint Cost	103,600	16,155	119,755
4.	Total Allocated Cost	103,600	16,155	119,755

1/ Submerged sediment 260 acre-feet
Aerated sediment 47 acre-feet
Floodwater detention 655 acre-feet

The construction cost of multiple-purpose structure 10 is estimated to be $95,004. P. L. 566 funds will provide $82,188 or 86.51 percent of this cost and $12,816 or 13.49 percent will be provided by the town of Braselton. The total engineering cost for the dam and reservoir is estimated to be $14,251. P. L. 566 funds will provide $12,329 of this cost and $1,922 will be provided by the town of Braselton. The total estimated cost for land rights (105 acres) for this structure is $10,500, all of which will be provided by the town of Braselton.

Multiple-Purpose Structure 21
Allocation of Total Cost

Item	Flood Prevention	Municipal Water Supply	Total
1. Total Capacity (Ac.Ft.)	2,754[1]/	737	3,491
2. Percent Total Capacity	78.89	21.11	100.00
3. Allocated Joint Cost	184,331	49,325	233,656
4. Total Allocated Cost	184,331	49,325	233,656

1/ Submerged sediment 599 acre-feet
Aerated sediment 108 acre-feet
Floodwater detention 2047 acre-feet

The construction cost of multiple-purpose structure 21 is estimated to be $188,614. P. L. 566 funds will provide $148,798, or 78.89 percent of this cost and $39,816, or 21.11 percent will be provided by the city of Winder. The total engineering cost for the dam and reservoir is estimated to be $28,292. P. L. 566 funds will provide $22,319 of this cost and $5,973 will be provided by the city of Winder. The total estimated cost for the land rights (210 acres) for this structure is $15,750, all of which will be provided by the city of Winder. The cost of modifying a dirt road and culvert is estimated to be $1,000, which will be provided by Barrow County.

Project administration costs will be provided by the Service and the sponsoring local organizations in the amounts that are shown in Tables 1 and 2.

Project administration costs associated with the installation of structural measures to be provided by the Service include construction surveys, construction inspections, review of engineering plans prepared by others, and government representatives to insure that the structural measures are installed in accordance with plans and specificiations.

Project administration costs associated with the installation of structural measures to be provided by the sponsoring local organizations include administration of contracts, review of engineering plans prepared by others, and construction inspection.

EFFECTS OF WORKS OF IMPROVEMENT

The installation of the land treatment measures will reduce erosion, increase infiltration rates, provide for the orderly removal of surface water from upland fields, maintain productivity of the soil and assure the realization of the greatest benefits on individual farms from the structural works of improvement. It is estimated that sheet erosion of cultivated land will be reduced from 31.8 tons of soil per acre being removed annually to 23.8 tons of soil per acre being removed each year. It is also estimated that the average sediment concentration will be reduced from 360 PPM to 100 PPM, a reduction of 260 PPM. The suspended sediment based on normal flow would be reduced from 35 PPM to 10 PPM, a reduction of 25 PPM as a result of the project.

The planned structural measures will benefit approximately 140 different landowners or operators on about 2,404 acres of land. With the project installed all reaches below structures will be provided three-year protection or better except the following areas: the extreme lower end of Upper Mulberry River and Little Mulberry River and on Little Mulberry River from station 547+50 to 638+25, also on Duncan Creek just above its confluence with Wheeler Creek. These small areas will receive some flooding by the annual flood event. With the project installed, the area inundated by the 100-year frequency flood will be reduced 40 percent, the 25-year flood by 53 percent, the 5-year flood by 68 percent, the 2-year flood by 69 percent and the annual flood, 89 percent. Crop and pasture damages will be reduced by 78 percent; non-agricultural damages will be reduced by 89 percent.

As a result of project installation, cropland will be reduced by about 327 acres, most of which will be shifted to improved pasture. The project will allow the shifting of row crops from marginal upland fields to the more productive bottomlands and will permit the more erosive uplands to be planted to grasses or trees. In addition, 300 acres of critically eroding areas will be stabilized by land treatment measures. With flooding reduced in number and intensity, farmers will be willing to use their flood plain lands more intensively, adding additional production inputs such as fertilizer, etc. in trying to achieve maximum production and the most effective use of their land. The more intensive use of the protected flood plain land is expected to increase stability of family farms through more efficient operations, reduced costs, and increased net returns. Future land use in the watershed is expected to be 3,541 acres of cropland, 41,461 acres of woodland, 11,553 acres of pastureland and 4,926 acres in miscellaneous uses.

The installation of stream bank protection measures will significantly reduce the acreage of land lost annually by stream bank erosion. Another beneficial effect would be the significant reduction in suspended sediment after project installation. The difference in concentration results in a 72 percent reduction in long-term average annual suspended sediment.

The flooding of flood plain lands, roads, bridges, etc. result in damages and hardships to individual and businesses not necessarily associated with flood plain land ownership. This type of damage is considered to be

an indirect damage. These damages will be reduced significantly as a result of the project being installed.

Unemployed and underemployed labor in the watershed area will benefit from employment opportunities in the construction phase as well as in the operation and maintenance of the project.

Municipal water stored in multiple-purpose structures number 10 and 21 will benefit approximately 8,600 people in and around the towns of Braselton and Winder, who are served by the water systems. This water storage will be used by the expanding residential and industrial growth both in and outside the watershed. The water quality will meet health standards and the supply is dependable.

Most of the streams on which the floodwater retarding structures are located have the water quality for potential incidental recreational uses. This is especially true at structures 11, 17, and 18. The Service will encourage and provide technical assistance to the landowners and sponsors in developing these sites for incidental recreation provided there is sufficient interest and adequate safety and sanitary facilities are installed where needed. The Sponsors will discourage the use of these sites where there is no reasonable assurance that adequate sanitary facilities will be provided.

It is expected that the overall fish resources will be enhanced because of the project. The 72 percent reduction in long-term average annual suspended sediment will greatly benefit the fisheries. The sediment reduction of 35 PPM to 10 PPM during base flow will improve the spawning conditions and allow for an increase in egg hatchability. The upland treatment of vegetating 623 acres of critical areas, conversion of upland cropland to grasses and trees, and the application of water control practices on 2,884 acres of cropland (gradient terraces, grassed waterways, etc.) will reduce the sediment runoff into the streams. The reduction of sediment pollution will enhance the environment of the fish communities. The 385 acres of sediment pools within the nine structures will produce approximately 30 lbs/acre. The edge effect of the sediment pools and proper management of the wildlife gate in structure no. 9 will more than offset any adverse effect to waterfowl. The upland game habitat will increase due to the management of an additional 1,663 acres of wildlife habitat.

PROJECT BENEFITS

Average annual flood damage reduction benefits are $42,320 (Table 5). Floodwater damage reduction benefits are $10,674, including $6,773 brought about by the restoration of fertile flood plain lands to their former productive use. Sediment damage reduction benefits are estimated to be $7,237 and erosion damage reduction benefits are $20,562. Indirect damage reduction benefits are $3,847.

More intensive land use benefits are $19,917 and changed land use benefits are $10,896. Municipal water supply benefits are $11,310 and land use and development benefits are estimated to be $7,841. Redevelopment

benefits amount to $36,913 and secondary benefits are estimated to be $23,077. Local secondary benefits were used in project justification, however, secondary benefits from a national viewpoint were not evaluated.

Total annual benefits as a result of project installation are estimated to be $151,428.

COMPARISON OF BENEFITS AND COSTS

Total average annual benefits are estimated to be $151,428. Average annual secondary benefits are $23,077 (Table 6).

The average annual cost of the planned structural measures is $106,637 including $8,313 for operation and maintenance. The total benefit-cost ratio is 1.4 to 1.

The benefit-cost ratio without secondary benefits is 1.2 to 1.

PROJECT INSTALLATION

Land Treatment Measures

Individual landowners and operators will install the land treatment measures in cooperation with the Upper Chattahoochee River, Oconee River, and Upper Ocmulgee River Soil and Water Conservation Districts in accordance with the provisions of their district conservation plans. The Soil Conservation Service, the Georgia Forestry Commission in cooperation with the U. S. Forest Service, and the Georgia Game and Fish Commission will provide technical assistance for the planning and application of these measures. Technical assistance available through the going programs will be supplemented by project funds to accelerate the planning and application of these measures in order that they will be installed prior to or concurrently with the installation of the related structural measures. The sponsoring local organizations and the Service will inform the landowners of the importance of land treatment measures in their project and they will be encouraged to set goals for establishing these measures within the installation period of the project.

The following application of needed land treatment measures will be required prior to furnishing financial assistance in the installation of the structural measures:

1. The sponsoring local organization will obtain agreements to carry out recommended soil and water conservation measures and proper conservation plans from not less than 50 percent of the lands situated in the drainage area above each retention reservoir to be installed with Federal assistance.

2. The sponsoring local organization will be responsible for assuring that not less than 75 percent of the effective land treatment measures are installed, or their installation commenced, on those sediment source areas which, if uncontrolled, would require a material increase in the cost of construction, operation or maintenance of the structural works of improvement.

Forestland owners will be encouraged to apply and maintain the best forestry measures on their forestland. The U. S. Forest Service, in cooperation with and through the Georgia Forestry Commission, provides technical assistance in the planning and application of forestland treatment measures under the going Cooperative Forest Management Program. They will provide additional technical assistance with P. L. 566 funds for accelerating the preparation of forest watershed management plans which are a part of the Conservation Farm Plans. P. L. 566 funds will also accelerate the installation of forestry measures during the installation period.

The U. S. Forest Service, by and through the Georgia Forestry Commission, will provide technical assistance for the planning and application of the forestland treatment measures. Technical assistance will also be provided to assist the landowners and operators in special problems generated by urban development in the forested areas. This service to landowners could include advice on how to select trees to be left in developed areas to enhance aesthetic values, how to protect trees from damage when making "cuts and fills," and many others.

A forester trained in watershed management will be assigned to the watershed to assist and guide the landowners in the installation of the planned land treatment measures. One of the first objectives of the forester will be the preparation of watershed management plans on the woodlands as a part of the Conservation Farm Plans.

The 382 acres of critical area field planting, consisting of 300 acres of grasses and legumes and 82 acres of trees will be installed by individual landowners and the Service during the installation period of the project. The landowners, through farmer-district agreements with the Service, will provide a portion of their share of the costs by preparing seedbeds, applying lime, fertilizer, seed, and planting seedlings. The Service will provide funds for the purchase of seed, lime, fertilizer, mulch, and seedlings. The quantity and value of such work and materials will be determined by mutual agreement prior to the signing of the appropriate agreement and will be set forth in a project agreement. The districts will administer the contracts for this critical area field planting.

Structural Measures

The 7 floodwater retarding structures, 2 multiple-purpose structures, selective debris removal from approximately 8,750 feet of channel, approximately 85,675 linear feet of streambank protection, and 241 acres of critical area planting will be installed during the 5-year installation period.

Barrow County will provide the land rights and administer the contracts for the installation of the channel clearing and snagging, streambank protection, and the critical area planting in the Barrow County portion of the watershed.

Hall County will provide the land rights and administer the contracts

for the installation of floodwater retarding structures 6, 8, 17 and 18, streambank protection, and the critical area planting in the Hall County portion of the watershed.

Gwinnett County will provide the land rights and administer the contracts for floodwater retarding structures 7, 9, and 11, selective debris removal, and stream bank protection in the Gwinnett County portion of the watershed.

Jackson County will provide the land rights and administer the contracts for the installation of the streambank protection and critical area planting in the Jackson County portion of the watershed. The town of Braselton will provide the land rights and administer the contracts needed in connection with the installation of multiple-purpose structure 10. The city of Winder will provide the land rights and administer the contracts needed in connection with the installation of multiple-purpose structure 21.

The construction plans and specifications for multiple-purpose structures nos. 10 and 21 will be prepared by private engineers through negotiated A & E contracts let by the town of Braselton and the city of Winder. The negotiated engineering contract will provide for making field surveys, foundation and embankment stability investigations, and such other surveys or studies that are required in the preparation of the construction plans. Service engineers will approve work done under A & E contracts in accordance with established SCS policies. The cost for engineering services allocated to municipal and industrial water supply for structures nos. 10 and 21 will be borne entirely by Braselton and Winder. The cost for engineering services allocated to flood prevention for these structures will be borne entirely by P. L. 566 funds.

Hall County will be responsible for the road modifications necessary for the installation of structures nos. 17 and 18. Gwinnett County will be responsible for necessary road modifications for installation of sites 9 and 11. Barrow County will be responsible for road modifications necessary for installation of site no. 21. Jackson County will be responsible for the closing of unimproved county roads through reservior of site no. 10.

It is anticipated that all land rights will be acquired by the sponsoring local organizations during the first two or three years of the project installation period. These organizations have sufficient legal authority and/or funds and agree to use such authority and funds, if necessary, to acquire all of the land rights needed for the project.

Biologists of the Georgia Game and Fish Division, and Soil Conservation Service will be consulted on debris to be removed in connection with streambank stabilization and selective debris removal. These inspections will be to assist and consult with SCS engineers regarding selection of debris to be removed, the conduct of actual debris removal operations, and selection of methods by which streambank protection measures are conducted. The purpose of these inspections will be to advise SCS personnel on methods of protecting wildlife habitat and fishery resources.

No channel improvement or streambank protection located below structures will be installed until the upstream structure is installed or in the process of installation.

Pollution abatement measures will be installed in accordance with National policy on minimizing soil erosion and water and air pollution

during construction, as contained in Washington Engineering Memorandum-66. Georgia Engineering Memorandum-23 will be used in determining the kind and amount of pollution abatement measures that will be applied during construction in this project.

Construction methods during the project installation period will be such as to protect and preserve natural beauty, fish, wildlife, recreation and environmental resources.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the planned works of improvement as described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended. This financial and technical assistance to be furnished by the Soil Conservation Service and the U. S. Forest Service is contingent upon the appropriation of funds for this purpose.

The sponsoring local organizations have analyzed their financial requirements in consideration of the scheduled installation of the works of improvement and funds will become available through donations, cash reserves, tax revenues, and credit. Adequate provisions have been made for organization expenses that will occur in the process of installing the project.

Land Treatment Measures

The costs involved in the establishment of openland and forestland treatment measures for watershed protection will be provided by landowners and operators from their own resources and ACP cost-sharing. P. L. 566 funds will provide the accelerated technical assistance necessary for the installation of these measures and will also provide cost-sharing for the installation of critical area planting measures.

Structural Measures

It is expected that most of the land rights for all structural measures will be donated by interested landowners and will become available as scheduled for construction. The sponsoring local organizations will provide funds from their own resources to secure the land rights that are not donated.

The city of Winder and the town of Braselton will secure a loan of approximately $46,000 and $15,000, respectively, to pay for their share of construction and engineering costs associated with multiple-purpose structures nos. 10 and 21. The Sponsoring Local Organizations will enter into an agreement for repayment of the loan approved by the Farmers Home Administration prior to the execution of a project agreement.

The city of Winder and the town of Braselton have also filed letters of intent with the Farmers Home Administration to use the loan provisions

of Public Law 566 to acquire land rights and other FHA loans to install water treatment plants, distribution systems, and related facilities.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures on the openland will be operated and maintained by individual landowners under agreements with the Oconee River, Upper Chattahoochee River, and Upper Ocmulgee River Soil and Water Conservation Districts. The Soil Conservation Service and the Georgia Game and Fish Commission will furnish the technical assistance necessary for the operation and maintenance of these measures.

The forestland treatment measures will be maintained by the landowners and operators under agreement with the Oconee River, Upper Chattahoochee River and Upper Ocmulgee River Soil and Water Conservation Districts. The technical assistance to landowners and operators necessary for maintaining the forestland treatment measures will be provided by the going Cooperative Forest Management Program. They will also continue to furnish fire protection under the Cooperative Forest Fire Control Program.

Structural Measures

Gwinnett County will be responsible for the operation and maintenance of floodwater retarding structures 7, 9, and 11, and streambank protection in the Gwinnett County portion of the watershed.

Hall County will be responsible for the operation and maintenance of floodwater retarding structures 6, 8, 17 and 18, streambank protection, and critical area planting in the Hall County portion of the watershed.

Barrow County will be responsible for the operation and maintenance of channel improvement, streambank protection, and the critical area planting in the Barrow County portion of the watershed.

Jackson County will be responsible for the operation and maintenance of streambank protection and the critical area planting in the Jackson County portion of the watershed.

The town of Braselton will be responsible for the operation and maintenance of multiple-purpose structure 10.

The city of Winder will be responsible for the operation and maintenance of multiple-purpose structure 21.

The Georgia Game and Fish Commission will be consulted on the operation and maintenance of all detention reservoirs for fishery and waterfowl management. These reservoirs will be operated and maintained in accord with the Commission's recommendations to achieve maximum production and utilization of fish and waterfowl.

The annual cost of operation and maintenance of critical area planting is estimated to be $3,156. This will consist of fertilization, reseeding where necessary and the elimination of undesirable woody growth.

The annual cost of operation and maintenance of all detention structures, channel improvement, and streambank protection measures is estimated to be $5,157. This includes the routine and recurring needs such as fertilizing vegetative cover on dams and removing obstructions from channels to major maintenance needs which could include repairing damaged concrete, steel, or earthen portions of a structure or channel.

The operation and maintenance of all works of improvement in the project will be in accordance with state and local health agency regulations.

Funds for financing these operations and maintenance costs for structural measures will be provided from donations by concerned landowners, cash reserves, credit, and tax revenue.

Inspections necessary to determine critical and timely maintenance of all works of improvements will be made by the Soil Conservation Service and the sponsoring local organizations. The designated Service employee responsible for such inspections and follow-up and the sponsoring local organizations will make joint inspections annually, after unusually severe floods, and after the occurrence of any other unusual conditions that might adversely affect the structural measures. These inspections will continue for three years following the installation of each structure. Inspections after the third year will be made annually by the sponsoring local organizations and they will prepare a report and send a copy to the Service employee responsible for operation and maintenance inspections and follow-up. The report will be reviewed by the Service and any evidence that inspections or needed maintenance are not being performed properly and promptly will be reported to the State Conservationist and he will take appropriate action on the reported deficiencies.

A record of maintenance inspections and operations will be on file with the sponsoring local organizations and will, at all times, be available for inspection by Soil Conservation Service personnel. Specific maintenance agreements will be executed prior to the issuance of invitation-to-bid on construction or installation of structural measures.

The estimated total average annual cost of operation and maintenance for all structural measures is $8,313 (Table 4).

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Upper Mulberry River Watershed, Georgia

Installation Cost Item	Unit	No. to be Applied Non-Fed. Land	Estimated Cost (Dollars) 1/ P.L. 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Ac.	3,541	0	55,636	55,636
Grassland	Ac.	11,553	0	470,138	470,138
Critical Area Planting	Ac.	300	48,000	12,000	60,000
Technical Assistance			41,514	18,783	60,297
SCS Subtotal			89,514	556,557	646,071
Forest Service					
Forestland	Ac.	5,700	0	57,000	57,000
Coop.Forest Fire Control Pgm.			0	5,300	5,300
Critical Area Tree Planting	Ac.	82	4,500	900	5,400
Technical Assistance			13,400	8,800 2/	22,200
FS Subtotal			17,900	72,000	89,900
TOTAL LAND TREATMENT			107,414	628,557	735,971
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Struc.	No.	7	789,443	0	789,443
Multiple-Purpose Structure	No.	2	230,986	52,632	283,618
Channel Improvement	Ft.	8,750	14,700	0	14,700
Streambank Protection	Ft.	85,675	36,288	0	36,288
Critical Area Planting	Ac.	241	134,960	0	134,960
Subtotal - Construction			1,206,377	52,632	1,259,009
Engineering Services					
Soil Conservation Service			180,958	7,895	188,853
Project Administration					
Soil Conservation Service					
Construction Inspection			37,770	1,259	39,029
Other			151,081	5,036	156,117
Subtotal - Administration			188,851	6,295	195,146
Other Costs					
Land Rights			0	265,875	265,875
TOTAL STRUCTURAL MEASURES			1,576,186	332,697	1,908,883
TOTAL PROJECT			1,683,600	961,254	2,644,854
SUMMARY					
Subtotal - SCS			1,665,700	889,254	2,554,954
Subtotal - FS			17,900	72,000	89,900
TOTAL PROJECT			1,683,600	961,254	2,644,854

1/ Price Base - 1969

2/ Includes $6,500 from the going Cooperative Forest Management Program.

Date: April 1971

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At Time of Work Plan Preparation)

Upper Mulberry River Watershed, Georgia

Measures	Unit	Applied To Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Grassed Waterways	Ac.	121	12,100
Conservation Cropping Systems	Ac.	1,855	14,840
Crop Residue Use	Ac.	1,352	10,816
Gradient Terraces	Ft.	447,950	11,199
Drainage Laterals	Ft.	329,845	82,461
Tile Drains	Ft.	13,300	5,320
Wildlife Habitat Management	Ac.	1,196	29,900
Farm Ponds	No.	68	85,000
Pasture and Hay Planting	Ac.	8,148	488,880
Pasture and Hay Management	Ac.	4,199	209,950
Erosion Control (Woodland)	Ac.	1,650	82,500
Tree Planting and Seeding	Ac.	850	17,000
TSI	Ac.	1,500	15,000
Improvement Cuttings	Ac.	2,400	2,400
Cooperative Forest Fire Control Program	Ac.	43,011	86,000
TOTAL			1,153,366

1/ Price Base - 1969

Date: April 1971

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Upper Mulberry River Watershed, Georgia

(Dollars)[1/]

Item	Installation Cost P. L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
	Construction	Engineering	Land Rights	Total P.L. 566	Construction	Engineering	Land Rights	Total Other	
Floodwater Retarding Structures:									
No. 6	68,404	10,261		78,665			6,000	6,000	84,665
No. 7	73,752	11,063		84,815			7,875	7,875	92,690
No. 8	125,972	18,896		144,868			4,500	4,500	149,368
No. 9	99,030	14,855		113,885	(1,500)[2/]		9,750	9,750	123,635
No.11	86,352	12,953		99,305			18,500	18,500	117,805
No.17	176,131	26,420		202,551			36,500	36,500	239,051
No.18	159,802	23,970		183,772			151,000	151,000	334,772
Subtotal	789,443	118,418		907,861	(1,500)[2/]		234,125	234,125	1,141,986
Multiple-Purpose Structure:									
No. 10	82,188	12,329		94,517	12,816	1,922	10,500	25,238	119,755
No. 21	148,798	22,319		171,117	39,816	5,973	16,750	62,539	233,656
Subtotal	230,986	34,648		265,634	52,632	7,895	27,250	87,777	353,411
Critical Area Planting	134,960	20,244		155,204				[4/]	155,204
Channel Improvement	14,700	2,205		16,905			2,050	2,050	18,955
Streambank Protection	36,288	5,443		41,731			2,450	2,450	44,181
Subtotal	185,948	27,892		213,840			4,500	4,500	218,340
Total	1,206,377	180,958		1,387,335	52,632	7,895	265,875	326,402	1,713,737
Project Administration	XXXXXXXX	XXXXXXX	XXXXXX	188,851	XXXXXX	XXXXX	XXXXXXX	6,295	195,146
GRAND TOTAL	1,206,377	180,958		1,576,186	52,632	7,895	265,875[3/]	332,697[3/]	1,908,883

1/ Price base - 1969

2/ Non-Project Cost for Installation of Wildlife Drawdown Gate.

3/ Includes $160,500 for Relocation and Modifying Roads & Bridges

4/ State and County Owned Rights-of-Way

Date: April 1971

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Upper Mulberry River Watershed, Georgia

(Dollars)[1/]

Item	COST ALLOCATION PURPOSE			COST SHARING P. L. 566			COST SHARING OTHER		
	Flood Prevention	Municipal Water	Total	Flood Prevention	Municipal Water	Total	Flood Prevention	Municipal Water	Total
Single-Purpose									
Floodwater retarding structures 6, 7, 8, 9, 11, 17, 18; channel improvement, critical area planting and streambank protection.	1,360,326		1,360,326	1,121,701		1,121,701	238,625		238,625
Multiple-Purpose									
Multiple-purpose structure 10	103,601	16,154	119,755	94,517		94,517	9,084	16,154	25,238
Multiple-Purpose structure 21	184,331	49,325	233,656	171,117		171,117	13,214	49,325	62,539
GRAND TOTAL	1,648,258	65,479	1,713,737	1,387,335		1,387,335	260,923	65,479	326,402

1/ Price base - 1969

Date: April 1971

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Upper Mulberry River Watershed, Georgia

Item	Unit	Structure Number									Total
		6	7	8	9	10 3/	11	17	18	21	
Class of Structure		a	a	a	b	b	b	b	b	b	
Drainage Area	Sq. Mi.	2.34	2.81	2.77	3.35	2.79	6.41	8.90	16.78	8.73	54.88
Controlled	Sq. Mi.										
Curve No. (1-day) (AMC II)		71	72	72	72	72	72	72	72	73	
T_c	Hrs.	1.84	2.07	1.68	2.18	2.79	1.49	1.88	2.89	2.82	
Elevation Top of Dam	Ft.	897.5	1006.0	869.0	878.0	831.0	903.5	933.5	882.5	902.5	
Elevation Crest Emergency Spillway	Ft.	892.6	1002.1	864.5	873.0	824.4	897.6	926.0	876.0	894.0	
Elevation Crest High Stage Inlet	Ft.	888.0	997.9	856.5	865.0	820.1					
Elevation Crest Low Stage Inlet											
1st 50 Years	Ft.	876.8	986.1	836.9	853.1	813.4 2/	878.5	899.5	850.4	877.5 2/	
2nd 50 Years	Ft.	880.6	990.6	844.5	857.1		882.8	906.2	856.5		
Maximum Height of Dam	Ft.	33.0	34.0	54.0	34.0	38.0	35.5	52.0	47.0	56.5	
Volume of Fill	Cu. Yd.	33,000	52,000	150,000	86,000	67,000	73,000	161,000	85,000	102,000	809,000
Total Capacity	Ac. Ft.	692	879	939	1,290	1,112	1,990	2,798	4,966	3,491	18,157
Sediment Submerged 1st 50 Yrs.	Ac. Ft.	78	109	118	123		212	287	545		1,472
Sediment Submerged 2nd 50 Yrs.	Ac. Ft.	71	100	110	116	260 1/	199	270	503	599 1/	2,228
Sediment Aerated	Ac. Ft.	27	38	41	43	47	74	101	189	108	668
Municipal	Ac. Ft.					150				737	887
Retarding	Ac. Ft.	516	632	670	1,008	655	1,505	2,140	3,729	2,047	12,902
Between high and low stage	Ac. Ft.	263	328	324	392	326					
Surface Area											
Sediment Pool	Acres	17.9	21.6	13.4	28.7	35.8	45.2	37.3	75.8	70.4	346.1
Municipal	Acres					46.0				99.5	145.5
Retarding Pool	Acres	62.4	82.0	49.4	89.9	90.2	139.5	168.5	278.7	165.3	1125.9
Principal Spillway											
Rainfall Volume (areal) (1-day)	In.	7.00	7.00	7.00	7.50	7.50	7.50	7.50	7.50	7.50	
Rainfall Volume (areal) (10-day)	In.	12.50	12.50	12.50	13.00	13.00	13.00	13.20	13.20	13.00	
Runoff Volume (10-day)	In.	5.90	6.10	6.10	6.50	6.41	6.41	6.67	6.67	6.71	
Capacity of Low Stage (Max.)	c.f.s.	33	35	33	44	36	108	190	351	192	
Capacity of High Stage (Max.)	c.f.s.	65	112	128	107	110					
Frequency Operation-Emergency Spillway	%Chance	2>4	2>4	2>4	<2	2	2	<2	2	<2	
Size of Conduit	Dim-In.	24	30	30	30	30	30	36	48	36	

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Upper Mulberry River Watershed, Georgia

Item	Unit	Structure Number 6	7	8	9	10	11	17	18	21	Total
Emergency Spillway											
Rainfall Volume (ESH)(Areal)	In.	7.50	7.50	7.50	9.00	9.00	9.00	9.00	8.66	9.00	
Runoff Volume (ESH)	In.	4.14	4.26	4.26	5.58	5.58	5.58	5.58	5.28	5.71	
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	
Bottom Width	Ft.	50	100	100	100	75	200	150	400	100	
Velocity of Flow (V_e)	Ft/Sec.	2.35	3.59	2.96	3.51	6.00	6.45	6.06	5.18	6.72	
Slope of Exit Channel	Ft/Ft.	0.030	0.045	0.052	0.046	0.030	0.031	0.032	0.035	0.030	
Maximum Water Surface Elev.	Ft.	893.11	1002.9	865.1	873.8	826.0	899.6	927.9	876.7	896.0	
Freeboard											
Rainfall Volume (FH)(Areal)	In.	12.50	12.50	12.50	15.00	15.00	15.00	15.00	14.43	15.00	
Runoff Volume (FH)	In.	8.65	8.81	8.81	11.17	11.17	11.17	11.17	10.63	11.33	
Max. Water Surface Elev.	Ft.	897.3	1005.9	868.8	877.8	831.0	903.2	933.1	881.6	902.1	
Capacity Equivalents											
Sediment Volume	In.	1.41	1.65	1.82	1.58	2.06	1.42	1.39	1.38	1.52	
Retarding Volume	In.	4.13	4.22	4.53	5.63	4.40	4.40	4.51	4.17	4.40	

1/ 100-year Estimate
2/ Elevation of Municipal Pool (includes 100 year submerged sediment and municipal storage)
3/ All elevations are based on U.S.G.S. quadrangle sheet. A topographic survey and flood routing information must be obtained before final design data can be furnished.

Date: April 1971

TABLE 3A - STRUCTURE DATA

CHANNELS

Upper Mulberry River Watershed, Georgia

Channel (No. or Name)	Station or Reach	Drainage Area (Sq.Mi.)	Capacity c.f.s.		Hydraulic Gradient (Ft/Ft.)	Channel Dimensions		"n" Value		Velocities		Type of Improvement 1/
			Req'd	Design		Bottom (Ft.)	Depth (Ft.)	Aged	As Built	Aged	As Built	
MR	314+00	-0-		4/								SP
MR	932+00	25.52		4/								SP
LMR	515+00	-0-		4/								SP
LMR	547+50	0.67		4/								SP
LMR	638+25	3.55		4/								SP
LMR	690+00	5.52		4/								SP
LMR	690+00	5.52										S
LMR	777+50	9.23	1110	1134	0.0022	180 2/	40 3/	0.030	0.025	6.3	7.5	S
LMR	777+50	9.23		4/								SP
LMR	932+00	15.66		4/								SP

1/ S - Selective Debris Removal; SP - Streambank Protection
2/ Cross-sectional area (sq.ft.)
3/ Wetted perimeter (ft.)
4/ Improvement for Streambank Protection only.

Date: April 1971

TABLE 4 - ANNUAL COST
Upper Mulberry River Watershed, Georgia

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater retarding structures 6, 7, 8, 9, 17 and 18; multiple-purpose structure 10; channel improvement, critical area planting and streambank protection	68,748	6,829	75,577
Floodwater retarding structure 11; multiple-purpose structure 21; channel improvement and streambank protection.	19,508	1,484	20,992
Project Administration	10,068	XXXXXX	10,068
GRAND TOTAL	98,324	8,313	106,637

1/ Price base: Installation cost - 1969; O&M adjusted normalized.

2/ 100 years @ 5 1/8 percent interest.

Date: April 1971

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Upper Mulberry River Watershed, Georgia

(Dollars)[1/]

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	9,835	837	8,998
Road and Bridges	931	--	931
Other Fixed Improvements	939	194	745
Subtotal	11,705	1,031	10,674
Sediment			
Overbank Deposition	5,304	940	4,364
Swamping	4,733	1,860	2,873
Subtotal	10,037	2,800	7,237
Erosion			
Critical Areas	21,765	5,442	16,323
Scour	884	82	802
Streambank	4,810	1,373	3,437
Subtotal	27,459	6,897	20,562
Indirect	4,920	1,073	3,847
TOTAL	54,121	11,801	42,320

1/ Price base- adjusted normalized.

Date: April 1971

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Upper Mulberry River Watershed, Georgia

(Dollars)[1/]

Evaluation Unit	Average Annual Benefits								Avg. Annual Cost	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Changed Land Use	Municipal Water Supply	Land Use and Development	Redevelopment	Secondary	Total		
Floodwater retarding structures 6, 7, 8, 9, 17, and 18; multiple-purpose structure 10; channel improvement; critical area planting and streambank protection	35,649	14,817	8,106	3,934		24,208	16,615	103,329	75,577	1.4:1
Floodwater retarding structure 11; multiple-purpose structure 21; channel improvement and streambank protection	5,825	5,100	2,790	7,376	7,841	12,705	6,462	48,099	20,992	2.3:1
Project Administration	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXX	XXXXXX	XXXXXX	XXXXXXX	10,068	XXXXX
GRAND TOTAL	41,474[2/]	19,917	10,896	11,310	7,841	36,913	23,077	151,428	106,637	1.4:1

1/ Price base - benefits adjusted normalized. See table 4 for price base for costs.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $846 annually.

Date: April 1971

INVESTIGATIONS AND ANALYSES

Engineering

Watershed data used during the planning of this project included aerial photography of the watershed area, blueline base maps developed from aerial photographs and seven and one-half minute USGS quadrangle maps.

Field surveys were made to obtain valley and channel cross-sections and stream gradients for hydrologic analysis and channel designs. The distance between cross-sections for stationing and determining grade was made by map measurements. The centerline of dam profiles and topographic maps of 5-foot or 10-foot contour intervals were made on all finally selected reservoir sites using telescopic alidade and plane table except site number 10. This site was designed using stage-storage curve developed from USGS quadrangle sheet. All surveys were referenced to mean sea level datum.

Criteria established in SCS Engineering Memorandum 27 (Revised) were used in the design and classification of all detention structures. Floodwater detention was determined by the method established in National Engineering Handbook, Hydrology, Chaper 21, Revised. Low-stage detention is provided to accommodate the 24-hour, 5-year frequency storm for those structures with relatively small drainage areas and designed with two-stage risers.

A total of 16 potential structure sites were investigated in the process of selecting the most feasible system of structural measures to accomplish project objectives. Sufficient investigations were made on each of these sites to determine the engineering problems associated with each site and the development of sound cost estimates.

Cost estimates were based on current costs of similar construction work with consideration given to local site conditions.

All channels below structures were inspected by walking or floating in boat to determine present conditions and need for improvement.

Structure foundations were investigated by use of the probe rod and visual inspection. Emergency spillway sites, borrow, and abutments were examined by visual inspection. Adequate embankment material is available at all structure sites. Extensive borrow areas may be necessary for structure 21 due to relatively shallow depth to rock and limited plastic material.

No adverse downstream effects are anticipated from the planned structural improvements.

Hydraulic and Hydrologic

Sixty-nine channel and valley cross-sections that are representative of channel and flood plain characteristics were located and surveyed. Water surface profiles were developed for these cross-sections through the Water Surface Profile Computer Program operated by the ADP Unit of the South Regional Technical Service Center of the Soil Conservation Service.

The average soil-cover complex of the watershed was determined by a sampling procedure utilizing available conservation survey records of Barrow, Hall, Gwinnett, and Jackson Counties, work unit records of farms within the watershed, field inspections and representative field sample studies of the woodland areas.

Data from USGS stream gages located on Allen Creek at Talmo, Georgia, and Middle Oconee River near Athens, Georgia, were analyzed and used in checking the soil-cover complex, peak discharges, and direct runoff volumes in the Upper Mulberry River Watershed. As an additional check on peak discharges within the watershed, USGS Open File Report entitled "Floods in Georgia, Magnitude and Frequency" was utilized.

All flood routing was accomplished by the ADP Unit of the SRTSC, SCS, by use of the TR-20 program. A variety of floods of various magnitudes were routed for after land treatment, before structures and seven different structure systems. In determining the release rates from floodwater retarding and/or multiple-purpose structures, an analysis was made of the combined release rate from structure(s) and the channel capacity downstream.

The emergency spillway and freeboard hydrographs for the floodwater retarding and/or multiple-purpose structures were developed by a general simplified method as described on page 3.21-11, Supplement A, Section 4, NEH, SCS. Flood routing through reservoirs was accomplished by the ADP Unit SRTSC, SCS.

Reports from private engineers employed by Winder and Braselton show that the water yield from the contributing drainage areas upstream from multiple-purpose structures 10 and 21, in combination with the water to be stored for municipal and industrial use, is adequate to meet consumptive use needs during extended drought periods. For structure 10, these needs were estimated to be about 50,000,000 gallons, or 150 acre-feet, of raw water storage which would amount to a daily water use, including evaporation and seepage losses, of approximately 400,000 gallons for a drought of 120-day duration. The needs for

structure 21 were estimated to be about 240,000,000 gallons, or 737 acre-feet, of raw water storage which would amount to a daily water use, including evaporation and seepage losses, of approximately 2,000,000 gallons for a drought of 120-day duration.

Channel Stability

Most of the watershed was a part of the old drainage districts and portions of the Mulberry River and associated tributaries underwent dredging and alignment prior to 1920. The resultant alignment has been maintained since that time but some degrading is presently occurring in the Mulberry River as a result of sand pumping operations at different locations along the channel.

Channel banks are relatively stable in some parts of the watershed but there are areas where rapid degrading has caused trees and vegetation to fall in the channel resulting in streambank erosion at these points. Additional log and debris stoppages were noted on most all streams and tributaries where streambank damages are presently occurring.

Present streambank soils with anticipated improved conditions after construction indicate that channel capacities will remain adequate for an indefinite period.

The beds of the channels are a combination sand and gravel. Rock exposures were found on all channels and at some locations these outcrops were extensive enough to function as grade controls.

Soil Conditions

Soil conditions were determined from current soil surveys. All of Gwinnett County has been mapped and about 50 percent of the portions in Barrow, Hall, and Jackson Counties have been surveyed. These surveys furnished information as to soil type, slope and degree of erosion. This information was compiled into useable data to determine the hydrologic soil conditions and capability classes for both upland and bottomland soils.

Land Use and Treatment

The present land use (cropland, pasture, and forest) for the watershed was determined from work unit records, field inspections, and from knowledge of local agricultural leaders and workers.

The future land use and treatment needs are based on the capability of the land in accordance with principles of good land management, the objectives of the local people, and trends in land use as reflected by the judgment of the agricultural workers and the length of the installation period.

Fish and Wildlife

A reconnaissance survey to determine the fish and wildlife resources and the preservation and improvement of these resources was conducted by biologists representing the Bureau of Sport Fisheries and Wildlife, the Georgia Game and Fish Commission, and the Soil Conservation Service.

Sedimentation

Field studies of valleys were made to determine the extent to which recent sedimentation has occurred. Upland areas were studied to determine sources of sediment. Borings were made in flood plain areas and clogged channels.

Studies and computations were made of the drainage area above each dam site and acreages obtained for each type of land use and cover condition.

Individual studies were made of specific structure sites in the watershed that typified regional conditions, topography, soil and geology. Computations were in accordance with instructions in South Regional Technical Service Center's Guide to Sedimentation Investigations using Soil Series "K" factor values. Estimates of rates at which sediment will be produced in the future were developed from anticipated land use in the future, soil types, rainfall, length and degree of slope, delivery rates and cover conditions.

Individual studies and computations were made for roadside erosion and critical sediment producing areas.

Soil density in place is approximately 2,000 tons per acre-foot. Aerated sediment density was computed at 1,800 tons per acre-foot. Submerged sediment density was computed at 1,300 tons per acre-foot.

Channel sedimentation occurs primarily in the upper reaches of the Little Mulberry River and some of the smaller tributaries where the channels have become blocked by brush, logs, and other debris. Sand pumping operations along the main channel of Mulberry River have reduced the bed load to gravel with fine sand with most of the fines being either dipped out or pumped out for commercial purposes.

Geology

Geologic investigations consisted of a study of areal geology and examinations for structural features such as jointing and faulting which might affect design. The watershed is located in a crystalline region and displays no major stratigraphic problems. Rock and mineral determinations were of a general nature only.

Road networks were extensive enough to provide several rock exposures for determination of sub-surface geology and formation identification.

Exploration of proposed structure sites to determine depth to bedrock and nature of overburden in areas of excavation was accomplished with hand auger and probe rod. Most soils were found to be micaceous clayey silts.

Channel bank material is primarily moderately clayey silts and stable except in those areas where blockage has caused bank deterioration and erosion.

Rock outcrops, primarily granite gneiss, are extensive on Rock Creek and smaller tributaries in the watershed. These are presently functioning as grade controls in conjunction with isolated gravel bars.

Geologic conditions at proposed floodwater retarding structure sites were recorded on SCS Form 375, Preliminary Report of Geologic Investigation. Present information indicates that rock excavation will be required at sites 9, 17, 18 and 21. Rock was encountered in the foundation of all sites. Borrow materials at site 8 and 18 will be highly micaceous and will require special fill placement. Generally, borrow materials at the remaining structures will be suitable.

Economic

Basic data was obtained from local farmers, agricultural workers, experiment stations and Department of Agriculture publications. Adjusted normalized costs and prices were derived from "Interim Price Standards for Planning and Evaluating Water and Land Resources," a publication of the Water Resource Council dated April, 1966. In comparing benefits and costs, a 100-year evaluation period and 5-1/8 percent interest rate was used.

Landowners or operators of approximately 35 percent of the flood plain were interviewed to determine present land use, yields, damages, and anticipated land use and yield with various degrees of protection. Damages by various depths of inundation to crops and other fixed improvements were also determined through these interviews. The schedules were summarized and with the use of cost and price information, damageable values were determined.

The frequency method was used to appraise flood damages. The computer program for economics (Econ 2) was utilized in estimating damages in the future with and without the project. Crop and pasture damages were adjusted for recurrent flooding.

Sediment, scour, and swamping damages are based on the loss of production as a result of these damages. Streambank erosion damages are based on the land lost as a result of streambank erosion.

Restoration benefits were determined by estimating the net income with and without the project by restoring the flood plain to its former level of productivity. More intensive land use was determined by landowners and operators anticipated land use and yields after the project is installed taking into consideration land use capabilities of the flood plain. Changed land use benefits will accrue to land now flooded too frequently for economical use. Projected use is improved pasture, vegetables and feed crops for on farm use. This will enable retirement of eroding upland soils from cultivation (Effects of Works of Improvement). Present land use below the proposed floodwater retarding structures is 70 acres cropland, 702 acres of pasture and hayland,

274 acres idle and miscellaneous, and 819 acres of woods and brush. Future land use is expected to be 522 acres of cropland, 998 acres of pasture and hayland, 80 acres idle and miscellaneous and 265 acres of woodland. Crops presently grown are corn, 47 acres; vegetables, 3 acres; and grain, 20 acres. Future acreage of cropland is expected to be 247 acres corn, 125 acres grain and 150 acres vegetables. Restoration, and more intensive and changed land use benefits were discounted for 5 years at 5-1/8 percent interest.

Indirect damage reduction benefits are estimated to be 10 percent of the direct damage reduction benefits.

Municipal water benefits of $11,310 were estimated by a private consulting engineering firm employed by the towns of Winder and Braselton. These benefits were based on projected increased sales of water.

Land use and development benefits are estimated to be $7,841 annually. This is the amortized amount of the increase in value of the land adjacent to structure number 11. These benefits were based on interviews with local real estate agents and on increased land values of nearby watershed projects.

Redevelopment benefits are based on the wages paid to local labor involved in the construction and operation and maintenance of the proposed works of improvement. The value of the labor in construction was converted to an annual equivalent by amortizing over the life of the project. The value of labor in the operation and maintenance of the project works of improvement was calculated as a decreasing annuity for 25 years and amortized over the life of the project at 5-1/8 percent interest. The latter procedure was considered because no area can remain a chronic unemployment or underemployment area for a long period of time.

Secondary benefits were estimated to be 10 percent of the direct primary benefits, plus 10 percent of the added cost in production, annual associated costs, and annual operation and maintenance costs.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP

UPPER MULBERRY RIVER WATERSHED

PORTIONS OF

BARROW, GWINNETT, HALL AND JACKSON COUNTIES

GEORGIA

LOCATION MAP

LEGEND

- PAVED ROAD
- IMPROVED ROAD
- UNIMPROVED ROAD
- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- DRAINAGE
- WATERSHED BOUNDARY
- AREA BENEFITED
- DRAINAGE AREA CONTROLLED BY STRUCTURE
- FLOODWATER RETARDING STRUCTURE
- MULTIPLE PURPOSE STRUCTURE
  - (M) MUNICIPAL WATER
- STRUCTURE SITE NUMBER
- STREAMBANK PROTECTION
- CHANNEL IMPROVEMENT FOR FLOOD PREVENTION
  (SELECTIVE DEBRIS REMOVAL)

Site Numbers and Drainage Areas in Acres

No	Area
6	1,498
7	1,798
8	1,773
9	2,147
10	1,786
11	4,105
17	5,742
18	10,737
21	5,587

LATITUDE AND LONGITUDE LINES ARE APPROXIMATE

Rev. 4-71 A-R-28,707

Formerly 2-R-11,050 Ac. 64 4-R-25468

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STRUCTURAL MEASURES MAP

UPPER MULBERRY RIVER WATERSHED

PORTIONS OF

BARROW, GWINNETT, HALL AND JACKSON COUNTIES

GEORGIA

APPROX. SCALE 0 1/4 1/2 1 2 3 MILE

LOCATION MAP

LEGEND

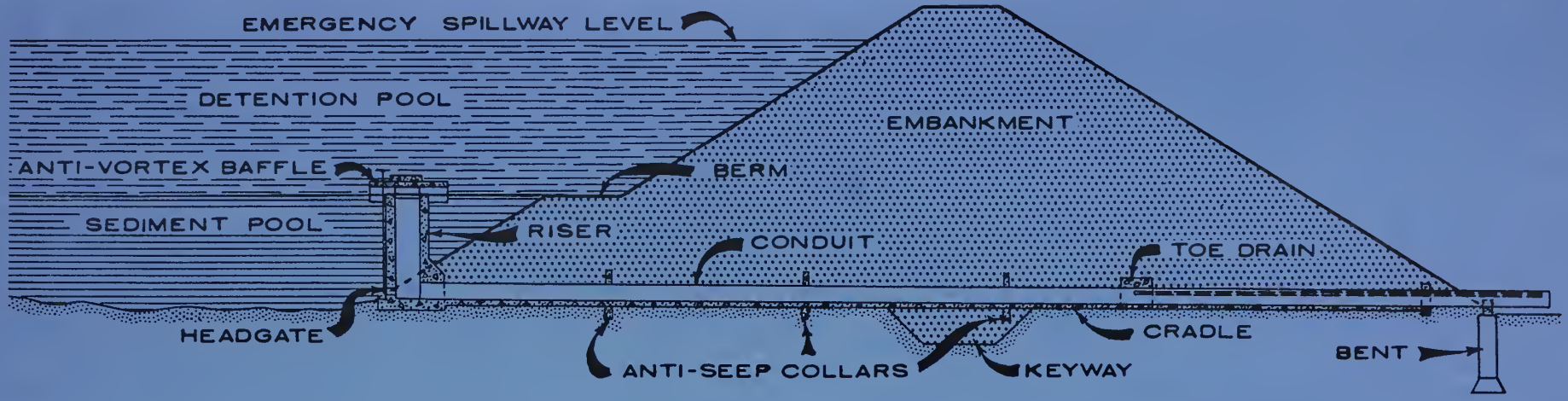
- PAVED ROAD
- IMPROVED ROAD
- UNIMPROVED ROAD
- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- DRAINAGE
- WATERSHED BOUNDARY
- FLOODWATER RETARDING STRUCTURE
- MULTIPLE PURPOSE STRUCTURE (NO MUNICIPAL WATER
- STRUCTURE NUMBER
- (TYPE, ZONE, AND/OR) (STRUCTURAL MEASURES)

SELECTIVE DEBRIS REMOVAL

- ROADS TO BE ALTERED

LATITUDE AND LONGITUDE LINES ARE APPROXIMATE

Formerly 2-R-11,050 Rev. 11-69 4-R-25,468



SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

FIGURE I

Formerly Dwg. No. MR56-209
U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Athens, Georgia
1-66 4-L-20994
USDA-SCS-FORT WORTH TEX. 1966